

Food of King Mackerel, *Scomberomorus cavalla*, in Onslow Bay, North Carolina

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ABSTRACT

The stomachs of 205 king mackerel, *Scomberomorus cavalla* (Cuvier), collected in Onslow Bay, North Carolina were examined for food items. The stomach contents of the 113 stomachs containing food were composed mainly of fish. The dominant fishes were Atlantic menhaden, *Brevoortia tyrannus* (35% occurrence) and Atlantic thread herring, *Opisthonema oglinum* (28% occurrence). Other fishes and invertebrates ranked from 14% to less than 1% in occurrence. Atlantic menhaden and Atlantic thread herring were primarily dominant in the stomachs of king mackerel collected during the spring and summer months. Those collected during the fall months had ingested a wider variety of forage with Atlantic menhaden and Atlantic thread herring being of minor importance.

The king mackerel, *Scomberomorus cavalla* (Cuvier), ranges regularly in the warm parts of the western Atlantic ocean from Brazil to North Carolina. It occasionally strays to the southern part of the Gulf of Maine (Bigelow and Schroeder 1953). Its size, strength, edibility, and availability make it an important sport and food fish along the southeast coast of the United States. In 1970 the sport catch for this region was estimated to be nearly 16,000 metric tons (Deuel 1973) and the commercial catch in excess of 1,800 metric tons valued at over 1 million dollars (Wheeland 1973).

Little is known of the biology of this species north of Florida. With two exceptions (Beaumariage 1973; Beardsley and Richards 1970), all the biological information has been compiled by Brazilian biologists (Alves and Tomé 1966, 1967a, 1967b, 1968; Costa and Paiva 1963, 1964, 1965, 1966, 1967, 1968, 1969, 1970, 1971, 1974; Fonteles-Filho 1968; Ivo 1972, 1974; Menezes 1969a, 1969b; Nomura and Costa 1966, 1968; Nomura and Rodrigues 1967; Rodrigues and Bezerra 1968). Only one study has been directed specifically at diet (Menezes 1969a), although diet has been mentioned incidentally by other investigators (Beaumariage 1973; Knapp 1950). This study is intended to contribute information on this species from an area of the western Atlantic not previously studied.

In this paper I report on the stomach contents of 205 king mackerel (533-1,562 mm fork lengths) collected during sport-fishing

operations from April 1968 to November 1973 in Onslow Bay, North Carolina. The fish were taken where available in water ranging from 3 to 30 m in depth. Since the sampling techniques used excluded the collection of very small mackerel, there was no comparison made of food items by fish size.

Onslow Bay is formed by a curve in the North Carolina coastline between Cape Lookout and Cape Fear. King mackerel migrate into the area in late March and early April and remain through December. They are found inshore (within 16 km) from late April through October and offshore (20-60 km) during November, December, and March. King mackerel are rarely encountered in Onslow Bay in January and February.

METHODS

The stomach was removed, sliced open, and inverted on a flat dry surface immediately after a fish was caught. In this way further digestion was halted. Identifiable items were counted and whole fish were measured (fork length in mm). Partially digested items not readily recognizable were saved dry in plastic bags for later identification. These items were identified by comparing known meristics with reference collection specimens. Scales, bone structures, type and number of gill rakers, tail scutes, chitinous exoskeletons, and shape and size of gizzards were helpful in identifying various food items.

Food organisms were separated taxonom-

TABLE 1.—Stomach contents of 113 king mackerel (533–1,562 mm fork length), collected in Onslow Bay, North Carolina, April 1968–November 1973.

Food item	Frequency of occurrence	Percent occurrence			Number of food items	Percent number	Size range (FL, mm)
		Total	Spring (N = 35)	Summer (N = 47)	Fall (N = 31)		
Invertebrates	8	7.1		4.3	19.4	11	4.5
squid	5	4.4		2.1	12.9	7	2.8
penaeid shrimp	4	3.5		2.1	9.7	4	1.6
Fish	110	97.3	100.0	97.9	93.6	235	95.5
<i>Brevoortia tyrannus</i>	39	34.5	48.6	44.7	3.3	66	26.8
<i>Opisthonema oglinum</i>	32	28.3	34.3	40.4	3.3	53	21.5
<i>Leiostomus xanthurus</i>	16	14.2	8.6	4.3	29.0	18	7.3
<i>Lagodon rhomboides</i>	9	8.0	2.9	6.4	16.1	11	4.5
<i>Pomatomus saltatrix</i>	6	5.3	5.7	4.3	6.4	18	7.3
<i>Mugil</i> sp.	6	5.3		6.4	9.7	13	5.3
<i>Anchoa</i> sp.	5	4.4	2.9	4.3	3.3	8	3.2
<i>Hyporhamphus unifasciatus</i>	5	4.4		2.1	12.9	8	3.2
<i>Micropogon undulatus</i>	4	3.5		2.1	9.7	5	2.0
<i>Synodus foetens</i>	2	1.8		2.1	3.3	2	0.8
<i>Scomberomorus maculatus</i>	2	1.8	2.9	2.1		2	0.8
<i>Bairdiella chrysura</i>	2	1.8			6.4	3	1.2
<i>Trachinotus carolinus</i>	2	1.8		2.1	3.3	3	1.2
<i>Caranx crysos</i>	1	0.9			3.3	2	0.8
<i>Caranx hippos</i>	1	0.9			3.3	1	0.4
<i>Decapterus</i> sp.	1	0.9			3.3	1	0.4
<i>Seriola zonata</i>	1	0.9		2.1		1	0.4
<i>Cynoscion</i> sp.	1	0.9			3.3	1	0.4
<i>Menticirrhus</i> sp.	1	0.9			3.3	1	0.4
<i>Strongylura marina</i>	1	0.9			3.3	1	0.4
<i>Peprilus triacanthus</i>	1	0.9	2.9			1	0.4
<i>Sphoeroides maculatus</i>	1	0.9	2.9			1	0.4
Unident. carangids	4	3.5		4.3	6.4	4	1.6
Unident. clupeids	1	0.9	2.9			1	0.4
Unident. exocoetids	1	0.9	2.9			1	0.4
Unident. fish	6	5.3	11.4	2.1	3.3	9	3.7

ically, then tabulated as percent occurrence and percent number. Monthly samples were grouped according to season: spring (April, May, June), summer (July, August, September), and fall (October, November, December).

RESULTS AND DISCUSSION

Ninety-two of the stomachs (45%) were empty, some probably the results of regurgitation, which was observed on numerous occasions just before a fish was boated. Since a hooked fish is able to struggle a great deal, it may become stressed to the point of regurgitation. Beaumariage (1973) also noted a similarly high percentage of empty stomachs (58.4%) and mentioned regurgitation as a possible cause.

In the 113 stomachs containing food remains, fish were the dominant items. They appeared in 97% of the stomachs and represented 96% of the total number of food items (Table 1). Invertebrates, represented by squid and penaeid shrimp, were of minor importance.

The Clupeidae was the dominant family. It was represented about equally by two species: Atlantic menhaden, *Brevoortia tyrannus* (35% occurrence, 27% number), and Atlantic thread herring, *Opisthonema oglinum* (28% occurrence, 22% number). Other species and invertebrates ranked from 14% to less than 1% by occurrence and from 7% to less than 0.5% by number.

With one exception (Knapp 1950), other studies have also found a high abundance of clupeids in king mackerel stomachs. Menezes (1969a) found clupeids to be particularly outstanding and the Atlantic thread herring to be the main clupeid occurring in the stomachs of king mackerel collected off Brazil. Beaumariage (1973) likewise found clupeids to be important items in the stomachs of Florida-caught king mackerel (59% occurrence) and represented by two species: the scaled sardine, *Harengula pensacolatae*, and the Atlantic thread herring. While Knapp, Menezes, and Beaumariage found invertebrates to be of slightly greater variety and importance than I found, there

is agreement in that squid and penaeid shrimp were apparently the dominant invertebrates in the king mackerel diet.

Seasonal differences were noted in the diet. During the spring and summer the two species of clupeids (Atlantic menhaden and Atlantic thread herring) occurred most frequently and other fishes and invertebrates were of minor importance. However, in the fall, the diet was more diverse with less emphasis on clupeids. The Atlantic menhaden and Atlantic thread herring each occurred in only 3% of the stomachs while other fishes and invertebrates were much more important.

The change in the fall diet may be the result of changes in food availability. Atlantic menhaden and Atlantic thread herring, which are abundant during spring and summer, are not readily available in autumn. Atlantic thread herring begin migrating south in September and are largely out of Onslow Bay by October (Pristas and Cheek 1973). Atlantic menhaden are relatively scarce in inshore ocean waters until migrating fish move into the area in November and December (Nicholson 1971). By that time most king mackerel have moved offshore. By contrast, many species that leave the estuaries to spawn and overwinter in ocean waters (Hildebrand and Cable 1930) become available as forage. Therefore conditions exist during this time of year that would provide a diverse diet with less emphasis on clupeids than in the spring and summer months.

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